DEVELOPMENT OF AN ULTRA-SAFE RECHARGEABLE LITHIUM-ION BATTERY

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R & D Status Report #1

Reporting Period: 15 August - 15 November, 1994

Submitted by:

The Electrofuel Manufacturing Company Inc.

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DEVELOPMENT OF AN ULTRA-SAFE RECHARGEABLE LITHIUM-ION BATTERY

R&D STATUS REPORT
1931-1001/0

ARPA Order No.: 9332004arp01/13APR1994/313ES
Program Code No.: ARPA-BAA93-32
Contractor: The Electrofuel Manufacturing Company Inc.
Contract No.: N00014-94-C-0141 Contract Amount: $1271728.
Effective Date of Contract: August 15, 1994
Expiration Date of Contract: February 14, 1996
Principal Investigator: J.K. Jacobs
Telephone No.: (800) 388-2865
Short Title of Work: Lithium-ion Battery Development
Reporting Period: August 15, 1994 to November 15, 1994

Description of Progress:

The project activities had an official start on August 15. Based on previous work, a statement of the basic design framework to be used was an important first step. The basic cell is to be a bonded flat-pack containing all active cell components in a sealed envelope. Cell integrity is to be provided by internal bonding, and not through external support. This design approach is fundamentally different from that commonly used in wound and hard-case cells, and has the advantage of ease of scaling for a variety of different form factors.

An innovative variant on the fan-fold geometry has been chosen for its manufacturability advantages. Equipment capable of handling the semi-continuous requirements of the fan-fold structure had already been outlined. There are specific advantages in at least three areas: 1) Control of dimensional tolerances; 2) Production rate; 3) Connection of power lead-outs and final assembly.

Cell chemistry is viewed to be of less fundamental importance than structural considerations within the bounds of the lithium-ion concept. That is, the program will maintain the flexibility to interchange cathode active material (various lithiated transition-metal oxides), anode active material (various carbons), and electrolyte (lithium organic and inorganic

salts dissolved in mixtures of ethers, organic carbonates, and other additives). The development of improved active materials is an area of intense interest world-wide. The program will maintain the capability of including the latest innovations as they become available from this program or from outside it. We define current baseline chemistry for this program (subject to change at any time) to be:

Anode - petroleum coke
Cathode - lithium cobalt oxide
Electrolyte - PC/DME/$LiPF_6$

Major activities through the first 60 days included the evaluation of bonding and packaging concepts and the integrated evaluation of the impact of these concepts on the pilot-plant make-up. Simultaneous work on the optimized preparation of anode, cathode and electrolyte blends and discussions with battery users to refine our understanding of their needs have provided valuable inputs to the pilot-plant development equation.

Battery packaging considerations and production of button cells were the primary activities of the later 30 days of the reporting period. Work in support of hand-crafted prismatic cells has also been undertaken.

Design of the flexible manufacturing line is farther advanced than had been expected at this time, with fabrication of prototype web-handling equipment (coater, laminator, drier, and associated ancillaries) expected to begin in early December. As this is the major focus of the program, an early start is considered prudent.

Discussion with users has shown some divergence of opinion on the extent to which charge-control devices should be incorporated into the cells, or alternatively, into a specialized charger. Users with intelligent loads (eg. laptop computers) tend to prefer to manage the charging algorithm themselves. Users with "replacement market" loads tend to prefer internal charge management and protection. Pending further review of the changing user requirements in this area, charger design has been rescheduled to start in the second quarter of '95.

Preparation of electrolyte (primarily drying) has been identified as an area which will require more-than-expected effort. While purchase and/or in-house preparation of electrolytes is readily accomplished at bench scale, pilot-scale quantities (10L/d) will require production-oriented methodology. Further evaluation is continuing.

Change in Key Personnel: None

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Summary of Substantive Information Derived from Special Events:

A Kick-off meeting was held on October 24. The wide ranging discussion on current needs and perspectives of military users provided a valuable starting point for user group reviews in this sector.

Problems Encountered and/or Anticipated: None

Action Required by the Government: None

Fiscal Status:

	Total Estimate of Program	US Govt Funding Obligation	Electrofuel Contribution
(1)Amt.currently provided on contract:	$1630421	$1271728	$358693
(2)Expenses & commitments to date:	$ 105409	$ 82219	$ 23190
(3)Funds required to complete work:	$1525012	$1189509	$335503